REMARKS/ARGUMENTS

Comments concerning Preliminary Amendment & IDS mailed on 23 November 2004

The first Office Action does not take into account the preliminary amendment and prior art statement that Applicants mailed to the Patent and Trademark Office on 23 November 2004. These were accompanied by a supplemental declaration of inventorship and a new power of attorney, as well as by copies of the cited references. A copy of the Information Disclosure Statement by Applicant form mailed to the Patent and Trademark Office on 23 November 2004 is attached to this response. It is presumed that the 23 November 2004 mailing has been delayed by security measures and will eventually be incorporated into the file history.

Claims 24 - 54 are now active in the application.

The nature of the first Office Action is such that it appears that response is possible, and response is made in order to further the prosecution.

Applicants considered the following references in preparing the portion of the appended Prior-Art Statement pertaining to the patentability of Claims 24 through 45.

U. S. patent No. 3,614,673 (Kang) is cited for its showing of the coefficients of a time-domain filter being established based on computations of pulse response made in the frequency domain, using DFT and IDFT.

U. S. patent No. 4,027,257 (Perreault) is cited for its showing of an adaptive frequency-domain equalization filter.

U. S. patent No. 4,027,258 (Perreault) is cited for its showing of updating the weighting coefficients of an adaptive time-domain equalization filter, based on computations made in the frequency domain using DFT and IDFT.

U. S. patent No. 4,100,604 (Perreault) is cited for its showing of an adaptive frequency-domain equalization filter that uses a sliding window to select time-domain sample sets for frequency-domain equalization.

U. S. patent No. 6,031,882 (Enge *et al*) is cited for its showing of the transmission channel being characterized by the correlation of a received reference signal with that reference signal as known a priori by the receiver.

U. S. patent No. 6,512,789 (Mirfakhraei), drawn from a different field of art, shows the transmission channel for a multi-tone signal being characterized by the correlation of a received reference signal with that reference signal as known a priori by the receiver.

U. S. patent No. 5,065,242 (Dietrich *et al.*), drawn from a different field of art, is of interest for its use of discrete Fourier transforms to adapt filter coefficients in ghost suppressors for video signals, a concern in the reception of analog TV signals.

U. S. patent No. 5,251,033 (Anderson *et al.*), drawn from a different field of art, is of interest for its use of discrete Fourier transforms to adapt filter coefficients in ghost suppressors for video signals, a concern in the reception of analog TV signals.

U. S. patent No. 5,276,516 (Bramley), drawn from a different field of art, is of interest for its use of discrete Fourier transforms to implement frequency-domain filtering in ghost suppressors for video signals, a concern in the reception of analog TV signals.

Independent Claim 24 is amended to recite "apparatus for generating, in response to the discrete Fourier transforms of successive portions of said digital baseband signal that provide a sampling window **moving through a succession of different positions in each of successive data fields**, an adaptive set of weighting coefficients for use by said bank of multipliers", an element neither shown nor suggested in enabling way by the art of record.

Independent Claim 27 is amended to recite "apparatus for generating, in response to the discrete Fourier transforms of successive portions of said amplitude-modulated intermediate-frequency carrier that provide a sampling window **moving through a succession of of different positions in each of successive data fields**, said adaptive set of weighting coefficients for use by said bank of multipliers", an element neither shown nor suggested in enabling way by the art of record.

Independent Claim 29 recites "apparatus for computing respective discrete Fourier transforms responsive to successive portions of said amplitude-modulated intermediate-frequency carrier that is amplitude-modulated in accordance with said selected one of said digital signals and any multipath distortion thereof, **said successive portions of said amplitude-modulated intermediate-frequency carrier providing a sampling window moving through a succession of different positions in each of successive data fields**; and apparatus for computing the weighting coefficients of said first adaptive digital filter so as to suppress an unwanted portion of said first adaptive digital filter response arising from the amplitude of said amplitude-modulated intermediate-frequency carrier being modulated in accordance with multipath distortion of said selected one of said digital signals, with **the computations of said weighting coefficients being based on said discrete Fourier transforms of said successive portions of said amplitude-modulated intermediate-frequency carrier providing said sampling window moving through said succession of different positions in each data field.**"

These apparatuses are absent from the receivers in the prior art references referred to above. These prior-art receivers compute the weighting coefficients of the adaptive digital filter responsive to a prescribed training signal time-division-multiplexed with payload signal. Such receivers rely on successive portions of said amplitude-modulated intermediate-frequency carrier providing a sampling window for the training signal, which window occurs just once per data field in an initial data segment thereof. The computations of the weighting coefficients of the adaptive digital filter in such receivers are based on the correlation of the training signal portion of the received signal with ideal training signal known a priori at the receiver. The computations of the weighting coefficients are not based on each of the discrete Fourier transforms of successive portions of said amplitude-modulated intermediate-frequency carrier providing a sampling window moving through a succession of different positions in each data field. The prior art does not teach that the data within data fields other than training signal can be used in DFT computations used to characterize the actual reception channel.

Dependent claim 48 specifies that "said first adaptive-filter-kernel computer is operable to compute the discrete Fourier transforms of successive portions of said first digital baseband signal that provide a sampling window moving through a succession of different positions in each of successive data fields". Dependent claim 51 specifies that "said first adaptive-filter-

kernel computer is operable to compute the discrete Fourier transforms of successive portions of said first phase-splitter response that provide a sampling window moving through a succession of different positions in each of successive data fields".

Independent Claims 24, 27 and 29 also distinguish over applicant Limberg's U. S. published patent application 20010033341 of 25 October 2001. In published patent application 20010033341 the apparatus for DFTs selects portions of the amplitude-modulated intermediate-frequency carrier that contain repetitive PN sequences, which portions are separated from each other by fields of data.

Claim 29 is of broader scope than original claim 1, so there is more definite support for its priority in provisional patent application serial No. 60/193,301 filed March 30, 2000. Claim 30 specifies that "said sampling window moving continually in time is a sliding window that generally advances a given number of samples at a time" — e.g. one sample at a time, as described in that priority document. Claim 31 specifies that "said sampling window moving continually in time generally moves block-by-block over contiguous successive portions of said amplitude-modulated intermediate-frequency carrier", an embodiment preferred at the time patent application serial No. 09/823,500 was filed. Support is found in the paragraph bridging pages 22 and 23 of the specification of patent application serial No. 09/823,500.

Claims 14, 15, 16, 17, 18, 19 and 20 are replaced by Claims 46-51. Applicants have considered the following references in preparing the portion of the appended Prior-Art Statement pertaining to the patentability of Claims 46-51.

U. S. patent No. 5,528,311 (Lee *et al*) is cited for its FIGURE 2 showing of the conventional complex equalizer composed of four individual digital filters. This reference is further cited for its FIGURE 1 showing of an alternative complex equalizer composed of three individual digital filters.

U. S. patent No. 5,799,037 (Strolle *et al*) is cited for its Figure 7 showing of a complex equalizer with FIR and IIR components, the IIR component using decision feedback.

U. S. patent No. 6,337,878 (Endres *et al*) is cited for its Figure 2 and Figure 3 showings of complex equalizers with FIR and IIR components, the IIR components using decision feedback.

U. S. patent No. 6,426,972 (Endres *et al*) is cited for its Figure 7 showing of a complex equalizer with passband FIR and baseband IIR components, the IIR component using decision feedback.

U. S. patent No. 5,528,311 (Lee *et al*) is evidence that it was nonobvious to persons skilled in the art that demodulation at intermediate phases, rather than in-phase and quadrature-phase, could reduce the complex equalizer to two individual digital filters. The complex demodulation in the other references is also done in-phase and quadrature-phase, rather than at intermediate phases.

Claim Objections

The first Office Action made specific objections to Claims 1 - 23 and required corrections of purely formal nature. While Claims 1 - 23 are no longer active in the application, the objections to these claims have been taken into consideration with regard to Claims 29 - 51.

It is respectfully requested that reconsideration be given to the requirement that the word "A" be inserted at the beginnings of independent claims to "Receiver apparatus". Since the claims begin with the words "Receiver apparatus" the indefinite article "A" is unnecessary for indicating that the "Receiver apparatus" is initially referred to or provides antecedent basis for references to "The receiver apparatus" in dependent claims. The indefinite article "A" is unnecessary for indicating that the word "apparatus" is used as a singular noun, because the specification is amended at page 68, line 5, to state explicitly that this is the case in the claims which follow. The insertion of the word "A" at the beginnings of independent claims to "Receiver apparatus" is resisted by Applicants because they are of the opinion that the insertion would make the scopes of their inventions as described in these claims less clear to those skilled in the art. One skilled in the art will readily perceive that applicants' inventions extend to receiver apparatus as variously incorporated into portions of digital communications receivers,

DTV sets, DTV set-top boxes (STBs), DTV recorders etc. The second paragraph of 35 U. S. C. 112 mandates that:

> "The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the **applicant** regards as his invention."

Applicants foresee that the phrase "a receiver apparatus" may be misconstrued as applying only to free-standing receiver apparatus, such as an STB.

A phrase such as "The claim 24 receiver apparatus" in the dependent claims was objected to, and correction to an alternative phrase such as "The receiver apparatus of claim 24" was required. This appears to Applicants to be merely an expression of a personal preference in claiming style, since either expression conforms to the second paragraph of 35 U. S. C. 112. A phrase such as "The claim 24 receiver apparatus" is more succinct and so would be preferred by many claim drafters, it is submitted. However, since this is purely a formal matter and should not affect the application of the Doctrine of Equivalents to the claims, applicants have amended the dependent claims in the manner required by the Office Action, in order to reduce the issues between the Examiner and the applicants.

In canceled claim 3, lines 5 & 6, "a digital baseband signal re-sampled at said prescribed baud rate" is not the same digital signal as "a digital baseband signal sampled at an oversampling rate higher than said prescribed baud rate" recited in canceled claim 2, lines 8 & 9. Most English-speaking persons would read these phrases in a group or *Gestalt* as a description of a particular signal, rather than considering the elements of the description individually. So, the required amendment of canceled claim 3, lines 5 & 6, to recite "the digital baseband signal re-sampled at said prescribed baud rate" seems to applicants to be misleading. Similarly, in line 20 of canceled claim 15 "digital baseband signal re-sampled at said prescribed baud rate" is not the same digital signal as "said digital baseband signal supplied from said digital synchrodyne circuitry". Similarly, in line 9 of canceled claim 20 "a real component of digital baseband signal re-sampled at said prescribed baud rate" is a different digital signal than "said real component of said digital baseband signal supplied from said digital synchrodyne circuitry".

Rejections under 35 U. S. C. 112, ¶ 2

Claims 5-12, 14-23, 25, 26 and 28 were rejected under 35 U. S. C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Besides referring to an antecedent, the definite article "the" has several meanings, as can be ascertained by consulting an English-language dictionary. A long-established claiming practice is to use the word "said", rather than "the", when referring back to an antecedent. The specification is amended at page 68, line 5, to state explicitly that this practice is followed in the claims. This should simply resolve many of the issues raised in the Office Action.

The word "the" does not refer to an antecedent in the phrase "the baseband digital modulating signal in accordance with which said selected one of said single-carrier digital modulation signals was generated" that appeared in lines 4 - 6 of canceled claim 5 and appears in lines 8 & 9 of claim 24 as currently amended. In this context "the" points out the *particular* baseband digital modulating signal which the estimation circuitry generates an oversampling-rate estimation of. Indicating the particular person or thing in a group that is to be considered is a common use of the definite article "the" that often has nothing to do with antecedence.

The word "the" does not refer to an antecedent in the phrase "the discrete Fourier transforms of successive portions of said oversampling-rate estimation of the baseband digital modulating signal in accordance with which said selected one of said single-carrier digital modulation signals was generated" that appeared in line 7 of canceled claim 5. In this context "the" *particularly designates* the discrete Fourier transforms being of the successive portions of said oversampling-rate estimation of the baseband digital modulating signal. In English "the property X of signal or element Y" is an example of a commonly used form of possessive phrase and "the" in such phrase may or may not refer to an antecedent.

Applicants agree that the antecedent basis for "said single-carrier digital modulation signals" in lines 4 & 5 of claim 1 was not absolutely clear. The currently active claims have been amended to cure this particular form of antecedent problem.

In claims 35 and 44, the word "the" in "the actual reception channel" is used in the sense of indicating that particular reception channel having no fellow or equal. The word "the" indicates that one so designated or distinguished, distinguishing from the ideal reception channel the characteristics of which are stored in ROM.

In claim 35, the word "the" in "the resulting product terms" is used to indicate that thing close at hand (i.e., to the term-by-corresponding-term multiplication of each of said discrete Fourier transforms of successive portions of said oversampling-rate estimation of the baseband digital modulating signal by said discrete Fourier transform characterization of ideal reception channel response as read from said read-only memory).

In claim 35, the word "the" in "the resulting quotient terms" is used to indicate that thing close at hand (i.e., the term-by-corresponding-term division of the resulting product terms by the discrete Fourier transform of the portion of said digital baseband signal corresponding with that said successive portion of said oversampling-rate estimation of the baseband digital modulating signal generating said discrete Fourier transform thereof used in said term-by-corresponding-term multiplication).

Antecedent basis for "said discrete Fourier transform characterization of ideal reception channel response" has been clarified in claims 25 and 35.

Claim 45 recites "a digital controlled oscillator for supplying at said oversampling rate digital descriptions of in-phase oscillations and quadrature-phase oscillations as components of complex oscillations, the frequency and phase of which said complex oscillations are controlled by an automatic frequency and phase control signal". This cures an alleged problem with canceled claim 15, line 44.

The Office Action indicates the Examiner did not understand the phrase "of a type that substantially preserves in its output signal the system function described in its input signal". This phrase distinguishes against interpolation filters that perform spectrum shaping, such as the interpolation filters that introduce Nyquist roll-off that are used in other embodiments of the invention. Applicants submit that the phrase is readily understood by those skilled in the art and reasonably familiar with technical English used in digital electronics. The system function of a

digital signal is the underlying signal that is sampled and digitized. The questioned phrase has been amended in claims 36 and 37 to call for an interpolation filter "of a type that <u>essentially</u> preserves in its output signal the system function described in its input signal". This makes clear that the interpolation filter could also be one in which the system function described in its input signal is preserved exactly in its output signal. In actuality, of course, there will always be some quantization noise associated with digitization.

Rejections under 35 U. S. C. 112, ¶ 1

Claims 1 - 28 were rejected under 35 U. S. C. 112, first paragraph, as failing to comply with the enablement requirement. Claims 1 - 23 were canceled from the application prior to examination, so their rejection is moot. The Office Action indicates that the Examiner had difficulty in relating the original claims to the figures of the drawing. The enablement requirement is usually determined from the content of the specification; the drawing is primarily a tool to facilitate prior-art searching. Claims 24 - 51 will be specifically related to figures of the drawing by way of example, as an aid to the Examiner, but this is not to be construed as limiting the scope of any of these claims to the specific embodiments shown in the drawing figures.

Independent claim 24 is illustrated in FIGURE 1 and in FIGURE 16 showing a specific type **130** of the FIGURE 1 filter **13** in detail. Receiver front-end **11**, demodulator and oversampling analog-to-digital conversion circuitry **12**, decimation filter **14**, and decoding apparatus **15**, **16**, **17**, **18** are shown in FIGURE 1. Independent claim 24 is also illustrated in FIGURE 3 and in FIGURE 17 showing the specific type **130** of the FIGURE 3 filter **13** in detail. Analyzer filter **131**, bank **132** of multipliers, and synthesizer filter **133** are shown in either of FIGURES 16 & 17. Each of FIGURES 16 & 17 shows on its right "apparatus for generating ... said adaptive set of weighting coefficients for use by said bank of multipliers".

Dependent claim 25 specifies this apparatus more particularly. As the specification indicates in lines 24-30 on page 18 and in lines 2-7 on page 46, the data slicer **20**, symbol coder ROM **21**, and interpolation filter **22** provide estimation circuitry in FIGURES 1 & 16. As the specification indicates in lines 12-20 on page 23, in FIGURES 3 and 17 Viterbi trellis decoder **40**, symbol coder ROM **21**, and interpolation filter **22** provide estimation circuitry. In both FIGURES 16 & 17 the apparatus for computing the discrete Fourier transforms of successive

portions of said oversampling-rate estimation of the baseband digital modulating signal is analyzer filter **023**. (See page 45, lines 12-15, of spec.) The ROM **27** for storing a discrete Fourier transform characterization of ideal channel response is shown in detail FIGURES 16 & 17 as well as in FIGURE 1. The computer circuitry for generating discrete Fourier transform descriptions of said set of weighting coefficients is the similar-DFT-terms combiner **26**, the operation of which is described at length in the specification with reference to the FIGURE 2 flowchart. (The set of weighting coefficients determining the response of a digital filter is commonly referred to as its "kernel".) Each of FIGURES 16 & 17 shows the bank **116** of digital lowpass filters recited in Claim 25.

Claims 24 and 26 are illustrated in FIGURE 1 and in FIGURE 18. Claims 24 and 26 are also illustrated in FIGURE 3 and in FIGURE 19. In both FIGURES 18 & 19 the apparatus for computing the discrete Fourier transforms of successive portions of said Nyquist-filtered oversampling-rate estimation of the baseband digital modulating signal in accordance with which said selected one of said single-carrier digital modulation signals was generated comprises analyzer filter **043**. In FIGURE 18 the "estimation circuitry … for generating a Nyquist-filtered oversampling-rate estimation of the baseband digital modulating signal" comprises the data slicer **20**, symbol coder ROM **21**, and interpolation filter **42**. In FIGURE 19 this estimation circuitry comprises Viterbi trellis decoder **40**, symbol coder ROM **21**, and interpolation filter **42**. The interpolation filter **42** performs the Nyquist filtering that provides ideal system function for the channel. Each of FIGURES 18 & 19 shows the bank **116** of digital lowpass filters recited in Claim 26.

Independent claim 27 is illustrated in FIGURE 8 and in FIGURE 20 showing a specific type **630** of the FIGURE 8 filter **63** in detail. Receiver front-end **61**, analog-to-digital conversion circuitry **62**, digital synchrodyne circuitry **64**, decimation filter **67**, and decoding apparatus **68** are shown in FIGURE 8. Independent claim 27 is also illustrated in FIGURE 9 and in FIGURE 21 showing the specific type **630** of the FIGURE 9 filter **63** in detail. Analyzer filter **631**, bank **632** of multipliers, and synthesizer filter **633** are shown in either of FIGURES 20 & 21. Each of FIGURES 20 & 21 shows on its right "apparatus for generating … said adaptive set of weighting coefficients for use by said bank of multipliers".

Dependent claim 28 specifies this apparatus more particularly. As the specification indicates in text at the conclusion of page 30, the data slicer **70**, symbol coder ROM **71**, and interpolation filter **72** provide estimation circuitry in FIGURES 8 & 20. In FIGURES 9 and 21 Viterbi trellis decoder **40**, symbol coder ROM **41**, and interpolation filter **42** provide estimation circuitry. Both FIGURES 20 & 21 show balanced amplitude modulator **73**, ideal-channel-response vestigial-sideband filter **74**, further analyzer filter **075**, and bank **118** of digital lowpass filters. Both FIGURES 20 & 21 show computer circuitry **78** for generating discrete Fourier transform descriptions of said set of weighting coefficients, through term-by-corresponding-term division of each of the discrete Fourier transforms of successive portions of said vestigial-sideband filter response by the discrete Fourier transform of the corresponding portion of said digitized amplitude-modulated intermediate-frequency carrier.

Claim 29 is couched in general terms readily related to any of FIGURES 1, 3, 4, 6, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20 and 21. FIGURES 3, 6, 9, 16, 18 and 20 differ slightly from FIGURES 1, 4, 8, 9, 17, 19 and 21, respectively, with regard to the circuitry for estimating transmitted symbols. Both types of estimation circuitry are familiar to those skilled in the adaptive equalizer art and were shown in separate figures to facilitate searching of the prior art. These differences are not at the points of invention. FIGURES 10 and 11 differ from each other in the way the digital synchrodyning to baseband is done, not at the points of invention. FIGURE 13 differs slightly from FIGURE 12 in that the adaptive digital filters are operated at baud rate rather than being oversampled. Applicants have sought to deal with the problem that the Doctrine of Equivalents has been eroding in the United States.

Claim 32 is illustrated by FIGURE 1, by FIGURE 3, by FIGURE 4, or by FIGURE 6. FIGURE 1 shows receiver front-end **11**, first adaptive digital filter **13**, and apparatus for computing the weighting coefficients of said first adaptive digital filter comprising elements **20, 21, 22, 23, 26, 27, 28, 29**, as claimed in claim 29. FIGURE 3 shows receiver front-end **11**, first adaptive digital filter **13**, and apparatus for computing the weighting coefficients of said first adaptive digital filter comprising elements **40, 21, 22, 23, 26, 27, 28, 29**, as claimed in claim 29. FIGURE 4 shows receiver front-end **11**, first adaptive digital filter **13**, and apparatus for computing the weighting coefficients of said first adaptive digital filter comprising elements **20, 21, 42, 43, 45, 28, 29**, as claimed in claim 29. FIGURE 6 shows receiver front-end **11**, first

adaptive digital filter **13**, and apparatus for computing the weighting coefficients of said first adaptive digital filter comprising elements **40, 21, 42, 43, 45, 28, 29**, as claimed in claim 29. FIGURES 1, 3, 4 and 6 each show first adaptive digital filter **13** being a baseband filter as recited in Claim 32. FIGURES 1 and 3 each show demodulator and oversampling analog-to-digital conversion circuitry **12** and apparatus **24** for computing said discrete Fourier transforms from successive portions of said digital baseband signal. FIGURES 4 and 6 each show demodulator and oversampling analog-to-digital conversion circuitry **44** and apparatus **46** for computing said discrete Fourier transforms from successive portions of said digital baseband signal.

With regard to claim 33, each of FIGURES 1 and 4 show decimation filter **14** and decoding apparatus **15, 16, 17, 18**; and each of FIGURES 3 and 6 shows decimation filter **14** and decoding apparatus **40, 16, 17, 18**.

FIGURES 1 and 3 each show the specifics of the claim 33 decoding apparatus that are set forth in claim 34. With regard to claim 35, FIGURES 1 and 3 each show estimation circuitry; apparatus **22, 23** for computing the discrete Fourier transforms of successive portions of said oversampling-rate estimation of the baseband digital modulating signal; ROM **27**; computer circuitry **26, 28** for generating discrete Fourier transform characterizations of the actual reception channel; and bank **29** of digital lowpass filters. Claim 36 specifies the estimation circuitry to be as shown in FIGURE 1. Claim 37 specifies the estimation circuitry to be as shown in FIGURE 3. Dependent Claim 38 does not lend itself to meaningful illustration by drawing.

FIGURES 4 and 6 each show the claim 39 specifics of the claim 33 apparatus for computing the weighting coefficients of said first adaptive digital filter. FIGURES 4 and 6 each show estimation circuitry; apparatus **43** for computing the discrete Fourier transforms of successive portions of said Nyquist-filtered oversampling-rate estimation of the baseband digital modulating signal; computer circuitry **45, 46, 28** for generating discrete Fourier transform characterizations of the actual reception channel; and bank **29** of digital lowpass filters. Claim 40 specifies the estimation circuitry to be as shown in FIGURE 4. Claim 41 specifies the estimation circuitry to be as shown in FIGURE 6.

Claim 42 is supported by FIGURE 7, which shows controlled oscillator **120**, first mixer **121**, first analog lowpass filter **122**, and first analog-to-digital converter **123**. The apparatus for

computing said discrete Fourier transforms from successive portions of said digital in-phase baseband signal is DFT computer **25** supposing FIGURE 7 to be a detail of the FIGURE 1 or FIGURE 3 receiver apparatus. The apparatus for computing said discrete Fourier transforms from successive portions of said digital in-phase baseband signal is DFT computer **45** supposing FIGURE 7 to be a detail of FIGURE 4 or of FIGURE 6. Dependent Claim 43 does not lend itself to meaningful illustration by drawing.

Claim 44 is supported by FIGURE 7, which shows second mixer **124**; second analog lowpass filter **125**, second analog-to-digital converter **126**, second adaptive digital filter **58**, digital-to-analog converter **59**, and third analog lowpass filter **60**. The other elements of claim 44 are shown in FIGURE 4 or 6 of which FIGURE 7 is a detail.

Claim 45 is illustrated by FIGURE 8 or by FIGURE 9. Each of the FIGURES 8 and 9 shows receiver front-end **61**, analog-to-digital conversion circuitry **62**, digital controlled oscillator **65**, digital synchrodyne circuitry **64**, digital lowpass filter **65**, decimation filter **67**, decoding apparatus **68** et seq., balanced amplitude modulator **23**, ideal-channel-response vestigial-sideband filter **24**, apparatus **25** for computing discrete Fourier transforms of successive portions of said vestigial-sideband filter response, computer circuitry **78**, **79** for generating discrete Fourier transform descriptions of the kernel desired in said first adaptive digital filter, and a bank **80** of digital lowpass filters. FIGURE 8 shows estimation circuitry comprising elements **70**, **71**, **72**. FIGURE 9 shows estimation circuitry comprising elements **81**, **71**, **72**. Dependent claims specifying the estimation circuitry have not been offered.

Claim 46 is illustrated by FIGURE 10 or by FIGURE 11. Each of the FIGURES 10 and 11 which shows receiver front-end **81**, first and second adaptive digital filters **88** & **89**; first adaptive-filter-kernel computer **95**, second adaptive-filter-kernel computer **96**, apparatus **90** for recovering a data stream from an equalized in-phase digital modulation signal, and apparatus **91** for recovering said automatic frequency and phase control signal. First and second adaptive digital filters **88** & **89** in FIGURE 10 and in FIGURE 11 apparently operate at baud rate, and claim 46 is amended not to recite the first and second decimation filters that are used when the adaptive digital filters are operated at an oversampling rate (e.g., as in FIGURE 12). FIGURE 10 shows synchrodyning circuitry **87**. FIGURE 11 shows synchrodyning circuitry **97**.

Claim 49 is illustrated by FIGURE 12, which shows apparatus **11, 83, 84, 85** for converting a selected one of said single-carrier digital modulation signals transmitted at radio frequencies to an amplitude-modulated intermediate-frequency carrier. FIGURE 12 shows analog-to-digital converter **86**, phase-splitter **100**, first and second adaptive filters **101 & 102**, digital synchrodyne circuitry **103**, first decimation filter **106**, second decimation filter **107**, first adaptive-filter-kernel computer **109**, second adaptive-filter-kernel computer **110**, apparatus **108** for recovering a data stream from an equalized in-phase digital modulation signal that is formed by combining said first decimation filter response and said second decimation filter response in a first way; and apparatus **104** for recovering said automatic frequency and phase control signal from an equalized quadrature-phase digital modulation signal that is formed by combining said first decimation filter response and said second decimation filter response in a second way.

Method claims 52 and 53 are illustrated in flowcharts of FIGURES 2 and 5. Dependent method claim 54 is illustrated by FIGURES 18 - 21 as apparatus, rather than in flowchart.

CLAIMS TABLE for FREQUENCY-DOMAIN EQUALIZERS

FIGURE 16	**24**, 25, **29**, 30, 31, 32, 33, 35, 36, 38, **52**, 54 (baseband equalizer)
FIGURE 17	**24**, 25, **29**, 30, 31, 32, 33, 35, 37, 38, **52**, 54 (baseband equalizer)
FIGURE 18	**24**, 26, **29**, 30, 31, 32, 33, 39, 40, **52**, 54 (baseband equalizer)
FIGURE 19	**24**, 26, **29**, 30, 31, 32, 33, 39, 41, **52**, 54 (baseband equalizer)
FIGURE 20	**27**, 28, **29**, 30, 31, 32, **52**, 54 (passband equalizer)
FIGURE 21	**27**, 28, **29**, 30, 31, 32, **52**, 54 (passband equalizer)

CLAIMS TABLE for TIME-DOMAIN EQUALIZERS

FIGURE 1	**29**, 30, 31, 32, 33, 34, 35, 36, 38, **52**, 53 (baseband equalizer)
FIGURE 2	**52**, 53 (baseband equalizer)
FIGURE 3	**29**, 30, 31, 32, 33, 34, 35, 37, 38, **52**, 53 (baseband equalizer)
FIGURE 4	**29**, 30, 31, 32, 33, 39, 40, **52**, 53 (baseband equalizer)
FIGURE 5	**52**, 53 (baseband equalizer)
FIGURE 6	**29**, 30, 31, 32, 33, 39, 41, **52**, 53 (baseband equalizer)
FIGURE 7	(claims of FIG. 1, 3, 4 or 6 that FIG. 7 is detail of), 42, 43, 44, **52**, 53 (complex baseband equalizer)
FIGURE 8	**29**, 30, 31, 45 (passband equalizer)
FIGURE 9	**29**, 30, 31, 45 (passband equalizer)
FIGURE 10	**29**, 30, 31, **46**, 47, 48, **52**, 53 (complex baseband equalizer)
FIGURE 11	**29**, 30, 31, **46**, 47, 48, **52**, 53 (complex baseband equalizer)
FIGURE 12	**29**, 30, 31, **49** (complex passband equalizer)
FIGURE 13	**29**, 30, 31, **49**, 50, 51, **52**, 53 (complex passband equalizer)
FIGURE 14	
FIGURE 15	

Comments concerning Unity of Invention &Patentability over Prior Art of Record

Some of the prior art cited in Applicants' 23 November 2004 mailing to the USPTO teaches DFT methods for characterizing the communication channel just at intermittent intervals when a prescribed training signal is transmitted. This teaches away from the use of DFT methods for characterizing the required equalization at intervals throughout the entire communication, using data rather than prescribed training signal as bases for DFT computation, a radically different concept taught in the rejected application. Insofar as the record shows, this latter concept was novel and non-obvious on March 30, 2001. Upon reflection, method claims appear to be the better way to claim this aspect of invention, and new claims 52 - 54 are accordingly offered. This aspect of the invention unifies the various species of apparatus shown in the FIGURES of the drawing. The primary thrust of Applicant's inventions is not generation of various species of digital-signal receiver apparatus *per se*, but rather to describe new channel equalization techniques which have broad application across all such apparatuses.

A common feature found in many of the drawing figures is the use of DFT methods in which the required equalization is determined at a succession of different positions in each of successive data fields, during times actual data are transmitted rather than a prescribed training signal. This common feature, while applicable to the wide variety of digital communication receivers that are known, unifies the invention. Once the principles of the invention involving this common feature are known to be applicable to one previously known type of receiver, it is questionable whether application of these principles to another previously known type of receiver is patentably distinct. Consequently, election of one species of the invention for further prosecution will not appreciably reduce the burden of the Examiner concerning search of the prior art. So, the fundamental justification for restriction of species is not found in the current circumstances. The Examiner is asked also to take into consideration the small-entity status of the applicants.

Applicants' search of the prior art indicates that experts in equalization filter design know that equalization can be conducted either in the time domain or in the frequency domain. Once the principles of the invention are known to be applicable to one of these domains, it is questionable whether application of these principles to the other of these domains is patentably

distinct. Essentially, receivers using different ones of the two types of equalization are operational equivalents of each other, despite structural differences between them.

None of the prior art cited in Applicants' 23 November 2004 mailing to the USPTO is suggestive of synchrodyning to baseband at -45° and at +45° angles to carrier, specifically so that the complex baseband equalizer structure can be halved. This aspect of invention is shown in FIGURES 10 and 11. FIGURE 12 shows the concept as modified to halve the amount of complex passband equalizer structure, which also is not shown in the prior art as currently of record. Applicants have been unable to find reference to synchrodyning to baseband at -45° and at +45° angles to carrier *per se*, separate from halving complex baseband equalizer structure, which reference would be of interest to claims 46 - 51.

Claim 46, directed to the structures of FIGURES 10 and 11, does not specify the use of DFT methods in which the required equalization is determined at a succession of different positions in each of successive data fields. However, its dependent claims 47 and 48 do, functioning as linking claims to this concept.

Claim 49, directed to the structures of FIGURE 12 and 13, does not specify the use of DFT methods in which the required equalization is determined at a succession of different positions in each of successive data fields. However, its dependent claims 47 and 48 do, functioning as linking claims to this concept.

It is noted that all claims are in the same field of art and prior-art searching is co-extensive.

Provisional Election of Species

Applicants provisionally elect the apparatus shown in FIGURES 1 and 16 for prosecution, while traversing any requirement for election of species. Claims 24, 25, 29, 30, 31, 32, 33, 35, 36, 38, 52, 54 are applicable to this apparatus.

If election of species is required and claim 24 is found patentable, rejoinder of its dependent claim 26 is requested . If election of species is required and claim 29 is found patentable, rejoinder of its dependent claims 34, 37, and 39 - 45 is requested. If election of

species is required and claim 52 is found patentable, rejoinder of its dependent claim 53 is requested.

Conclusion

The (941)-625-7024 phone number is a temporary number for the undersigned applicant while his home, damaged in Hurricane Charley, is being reconstructed. Sometime in the spring of 2005 the phone number for the undersigned applicant will again be (941)-624-4302.

Respectfully submitted,

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Enclosures: Transmittal Form
Fee Transmittal Form & Credit Card Payment Form (signed)
Fee Transmittal Form copy & Patent Application Fee Determination Record
Supplemental Declaration of Inventors
Copy of Information Disclosure Statement previously submitted 11/23/2005